Hybrid Power System for Xcalak, Mexico

by David Corbus 12/99

Background

Xcalak is a coastal fishing village located at the southern tip of the Yucatan Peninsula in eastern Mexico. The village has about 300 residents in 60 homes that have never been connected to the national utility grid because the small size and remoteness of the village made grid extension too expensive. However, there have been attempts to bring electricity to Xcalak. In fact, it has been electrified five times—four times with diesel-electric generators and the last time with a hybrid wind and photovoltaic (PV) system.

In 1992, after nearly a decade without diesel power, Xcalak received a 71-kilowatt (kW) renewable energy power system consisting of six wind turbines and a PV array. Other components in the hybrid system included a 400-kilowatt-hour (kWh) battery bank and a 40-kW inverter. The system was designed around a 220-V direct current (DC) electrical bus. Condumex S.A. installed the system. Condumex, located in Mexico City, has been the preeminent supplier of solar energy equipment in Mexico for many years. The new system was funded by the State of Quintana Roo and the federal PRONASOL rural development program.

The Xcalak hybrid system was energized in August 1992 and has been producing between 120 and 250 kWh of AC power per day, depending on the wind resource. Any electricity generated by the system that is not needed to satisfy the immediate electrical load is stored in the battery bank for use during times of low wind and solar output. System performance has been slightly better than expected, primarily because the wind resource has been greater than was originally predicted. However, because the village load has grown substantially, the system often cannot meet the demand. The Xcalak system performance is monitored by the Southwest Technology Development Institute (SWTDI) and the National Renewable Energy Laboratory (NREL).

During the last five years, several problems have surfaced. Several wind turbine alternators have been replaced and the PV array has been out of operation twice due to regulator and wiring failures. Problems with the inverter have caused prolonged system downtime. Many of these technical problems were not severe, however, and could have been fixed in a timely manner had there been an appropriate infrastructure in place for system maintenance. Salt corrosion has proven a problem on the wind turbines, necessitating the replacement of turbine parts and tower guy wires.

The Xcalak project has taught some important institutional lessons, principally things to avoid. The system was installed before a local electrification committee (patronate) was formed, leaving the ownership and responsibility for the system largely undefined. The Governor of Quintana Roo, who championed the project, was voted out of office in 1993. The utility company was never involved with the project and the locals have lacked the cohesion to organize themselves into a regulating body. In addition, the users were not originally charged for the electricity, which naturally caused consumption to balloon. There has been difficulty in getting the users to pay after a method for charging them was implemented.

Status

NREL began analyzing system performance data in 1994 and has provided technical assistance to the project since then on an ad hoc basis. To date, there have been few institutional changes with the Xcalak project; hence, the system is in danger of falling into disrepair. Technical challenges, although significant, are not the primary problem. Lack of system administration is the major impediment.

In August 1997, a Canadian contract was awarded to SWTDI to investigate the institutional and technical problems posed by the project. Since then,

with assistance from NREL, Sandia National Laboratories, the University of Quintana Roo, and Bergey Windpower Company, Inc., the turbine alternators have been repaired and significant maintenance performed on the wind turbines. Installation of electrical meters, tariff analysis and implementation, repair of the distribution grid, and work on the formation of a local administrative body that will be responsible for system administration, have continued.

Recently, NREL participated in a cross-team effort to solve some of the technical issues with the system; this includes working with the inverter supplier, AES, to try to upgrade the inverter so that the batteries can be charged from the diesel.

Planned Activities

NREL and SWTDI will continue to monitor the performance of the system and analyze the data, particularly given that the battery in the system is already five years old.

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Produced by the National Renewable Energy Laboratory, a U.S. Department of Energy national laboratory.

Printed with renewable source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste.

NREL/FS-500-24637